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Two new butterfly species (Lepidoptera: Rhopalocera) from Mount Cameroon, Gulf of Guinea Highlands, Cameroon

SZABOLCS SÁFIÁN[1,2] & ROBERT TROPEK[3,4]

[1]*Institute of Silviculture and Forest Protection Faculty of Forestry University of West Hungary Bajcsy-Zsilinszky utca 4. H-9400 Sopron, Hungary. E-mail: safian@bcghana.org*
[2]*Faculty of Science, University of South Bohemia, Branisovska 1760, CZ-37005, České Budějovice, Czech Republic*
[3]*Faculty of Science, Charles University in Prague, Vinicna, 7, CZ-12844 Prague, Czech Republic. E-mail: robert.tropek@gmail.com*
[4]*Institute of Entomology, Biology Centre, Czech Academy of Science, Branisovska 31, CZ-37005, České Budějovice, Czech Republic*

Abstract

A field survey of Mount Cameroon, South-West Province, Cameroon, revealed two butterfly species new to science. *Lepidochrysops liberti* **sp. nov.** (Lycaenidae) flies in the extensive mosaic of natural clearings in sub-montane forest above 1100 m a.s.l., whereas *Ceratrichia fako* **sp. nov.** (Hesperiidae) locally inhabits the forested narrow gullies in the same vegetation zone. Observations on the habitat and behaviour of both species are also presented.

Key words: *Lepidochrysops liberti* **sp. nov.**, *Ceratrichia fako* **sp. nov.**, Lycaenidae, Hesperiidae, sub-montane forest, endemism

Introduction

Mount Cameroon is a unique, isolated volcanic massif, laying in the southern part of the Gulf of Guinea Highlands, an area recognised as an important hotspot of biodiversity (Bergl *et al*. 2007). Mount Cameroon itself is the highest peak in West-Central Africa, rising from sea level to 4,095 m and hosting a complete range of altitudinal vegetation zones (Cable & Cheek 1998). The relatively long-term stability of climatic conditions (as Mount Cameroon was part of a larger forest refugium during glacial maximums at least during the late Quaternary (Maley 1996)), together with the spatial isolation of the montane environment of Mount Cameroon, have resulted in increased speciation rates and in high levels of endemism of various taxonomic groups of organisms (MINFOF 2014).

The Lepidoptera fauna of the entire Gulf of Guinea Highlands is still understudied, although several publications dealing with its central parts give information on the distribution of (sub)montane butterflies and moths (e.g. Libert 1991, 1997; Amiet & Libert 1995; Tropek *et al*. 2013, 2015; Maicher *et al.* 2016). In spite of their high conservation importance, the butterflies of Mount Cameroon still remain largely unknown, as no comprehensive publication exists, and the area was excluded from the monograph on West African butterflies (Larsen 2005).

During two field surveys in November–December 2014 and April 2015 targeting the Lepidoptera diversity of Mount Cameroon, the authors found two new butterfly taxa. They are described below and compared with their closest relatives. Emphasis is laid on the unique character of the (sub)montane habitats of the mountain.

Material and methods

The type series of both species were collected with conventional butterfly nets during field surveys by the authors. The following closely related species were examined for comparison. The holotype of *Lepidochrysops phoebe* Libert, 2001 was examined from high quality photographs taken in the Natural History Museum, Paris, while the

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paratypes were also examined from high quality photos taken by Michel Libert in his personal reference collection. High quality digital photographs of the types of *Ceratrichia lewisi* Collins & Larsen, 2000, and *C. manengouba* Larsen & Collins, 2014 were available for examination in Larsen & Collins (2014); they are also illustrated below for comparison with their new relative. Type series of *C. lewisi* and *C. manengouba* were also examined by the first author in the African Butterfly Research Institute, Nairobi, Kenya (ABRI). Holotypes of both newly described species will be stored in the ABRI collection, while paratypes will be distributed to the Zoological Museum of Jagellonian University, Cracow, Poland (ZMJU) and the Natural History Museum, Paris, France (NHMP) and will be kept in the authors' reference collections (RT, SZS).

The process of digital images of photographed specimens and genitalia follows those described in Sáfián *et al.* (2015) and Collins & Sáfián (2014). The occurrence map was edited in the Adobe Photoshop CS5 photo editor program with the aid of the Google Earth GIS freeware program. The genitalia dissected and examined are numbered and stored in vials attached to the specimens (see reference numbers below).

Reference for venation and individual veins follows the simplified "English" or numerical system (Miller 1970), which is also used in modern works on African butterflies (Larsen 1991, 2005).

Taxonomic accounts

LYCAENIDAE Leach, 1815

Polyommatinae Swainson, 1827

Lepidochrysops Hedicke, 1923

Lepidochrysops liberti sp. nov.

(FIGS: 1A, B; 2A, D, C, F; 3A, 4)

Holotype. ♂ PlantiCam camp, along the main tourist trail, south-western slope of Mount Cameroon, South-West Province, Cameroon 23.XI–18.XII.2014. Leg.: Sáfián, Sz. & Tropek, R.; Gen. prep.: SAFI00076. Coordinates: N 04.117°, E 09.073°, elevation: 1100–1200 m a.s.l.

Paratypes. 6♂♂, 1♀ PlantiCam camp, along the main tourist trail (1100–1200 m a.s.l.), south-western slope of Mount Cameroon, South-West Province, Cameroon; 23.XI–18.XII.2014. Leg.: Sáfián, Sz. & Tropek, R.; 1♂ PlantiCam camp, along the main tourist trail (1100-1200 m a.s.l.), south-western slope of Mount Cameroon, South-West Province, Cameroon; 23.XI–18.XII.2014. Leg.: Sáfián, Sz. & Tropek, R.; Gen. prep.: SAFI00075.

Description of the holotype. Forewing: 18.5 mm. Wingspan: 31 mm. Upperside ground colour is white, with light blue scaling at the base of both wings, which extends into the cell (covering approximately one-third of the cell) also along the veins to a variable length. The forewing apex is broadly black, only slightly tapering down along the outer margin. The forewing costa is also narrowly black beyond veins 8, 9 and 10. A prominent black streak is present at the end of the discoidal cell. The hindwing has only a narrow black margin, with inconspicuous black sub-marginal spots in spaces between veins 1 and 7, except in space between veins 2 and 3, where a prominent black round-spot is present. The spot is ringed with orange basally. The veins are black, more strongly in the outer half of the wings. A fine hair-tail is present at the end of vein 2 of the hindwing. The underside is white with a slight light-brown tinge and very light whitish-blue scaling in the base of both wings. The black upperside markings are visible only as a pale brown shade, five brown spots forming a post-median line in spaces between veins 2 and 7 of the forewing, the central spot is more like a streak, protruding slightly from the line. On the hindwing a rather irregular median line is formed by seven, more or less circular brown spots, the central of which is characteristically long and elliptic. Four black dots are also present in the sub-basal area of the hindwing, two along the inner margin (the basal one is very small and inconspicuous), one in the cell and one near the costa.

The prominent marginal black spot of the hindwing upperside at the base of the hair-tail is large also on the underside, it is black with turquoise blue scales marginally, and ringed with orange. The body is black dorsally, with bluish-white hairs, white ventrally. The legs and the palpi are also white. The eyes are bald, brown. The antennae are black, ringed with white.

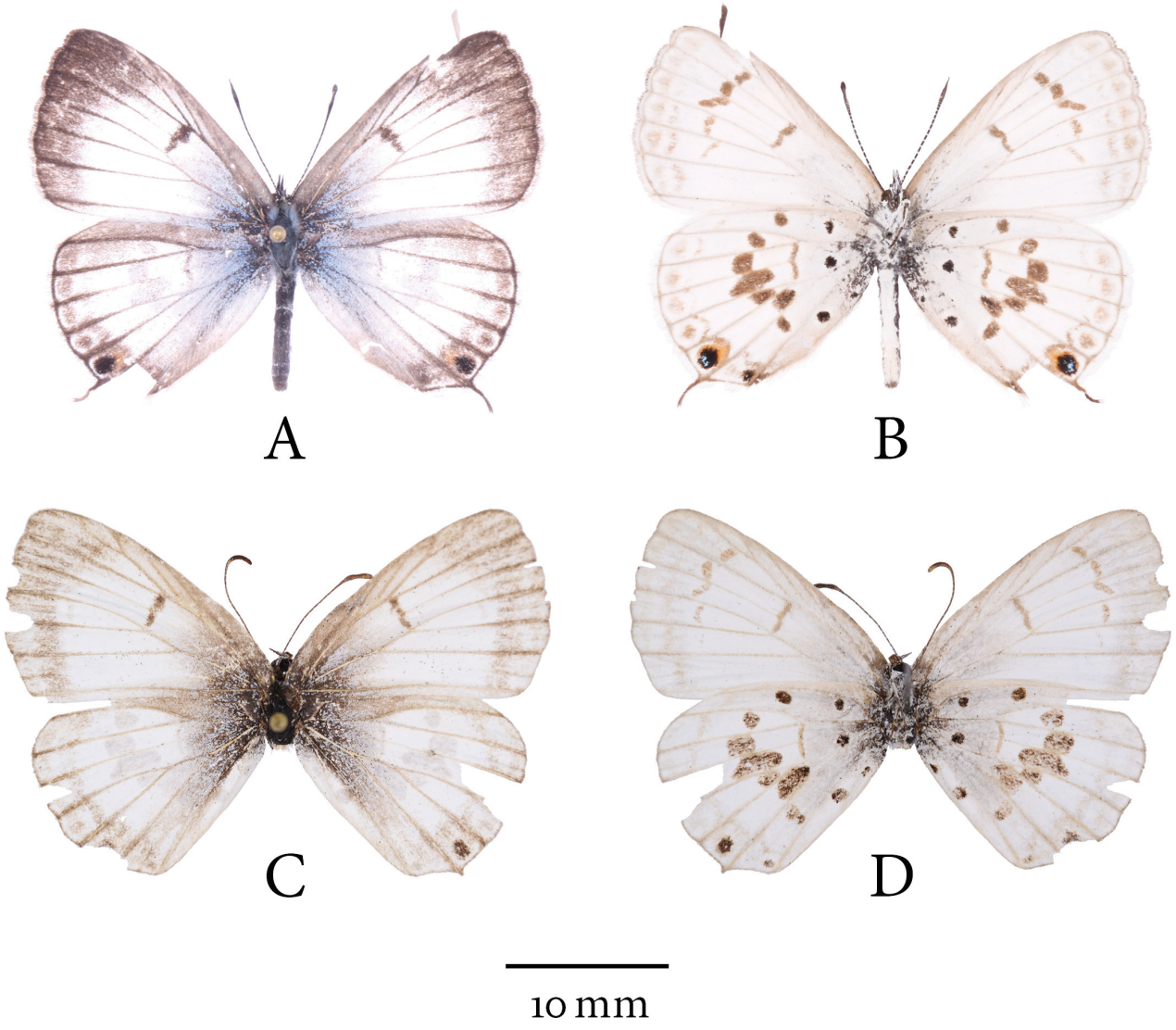

FIGURE 1. *L. liberti* (holotype): A—upperside, B—underside; *L. phoebe* (holotype): C—upperside, D—underside.

Male genitalia. Uncus blunt, parallelogram shaped with long hairs. Sub-unci long, slender, strongly curving. Valvae narrow with long hairs, their dorsal edge gently, ventral edge strongly curving. The tips are strongly hooked. Aedeagus is broad and short, the tip is rather acute and bifurcate.

Description of the female. Forewing: 20.5 mm, Wingspan: 40.5 mm. The general appearance of the female is very similar to that of male, however the size is generally larger, the forewing apex is slightly less acute and the black markings are stronger.

Diagnosis. Although the newly described *L. liberti* is morphologically very close to *L. phoebe*, the following differences allow safe identification of both taxa: the black margin on the forewing upperside of *L. liberti* is completely black, while a row of ill-defined white spots is present between the tornus and vein 4 in *L. phoebe*. There is a row of black spots along the margin of the hindwing upperside between veins 1 and 7 in *L. liberti*, while in *L. phoebe* the margin is broadly black, framing white lunules between veins 1 and 7 with an additional inner sub-marginal black line. This is also present on the hindwing underside in *L. phoebe*, where the inner line is formed by gently curving short streaks. A full row of black streaks also form an inner sub-marginal line from the inner margin and the costa on the forewing in *L. phoebe*, while the row of black streaks is not full in *L. liberti* and they are never connected in forming a line. The most conspicuous black spot at the base of the hairtail between veins 2 and 3 is faintly ringed with orange from its basal side in *L. liberti*, while orange is absent in *L. phoebe*. The orange ring

around the black spot is even more pronounced on the underside of *L. liberti*, while it is completely absent or vestigial in *L. phoebe* (the black spot is ringed with white). No female of *L. phoebe* is known so far. The male genitalia of the two species are also similar and as in several groups of *Lepidochrysops* might not be diagnostic, however the uncus is parallelogram-shaped in *L. liberti*, while it flattens dorsally in *L. phoebe*. Also the tip of the aedeagus is bifurcate in both dissected males in *L. liberti*, whereas the tip in *L. phoebe* tapers down ventrally in the lateral view.

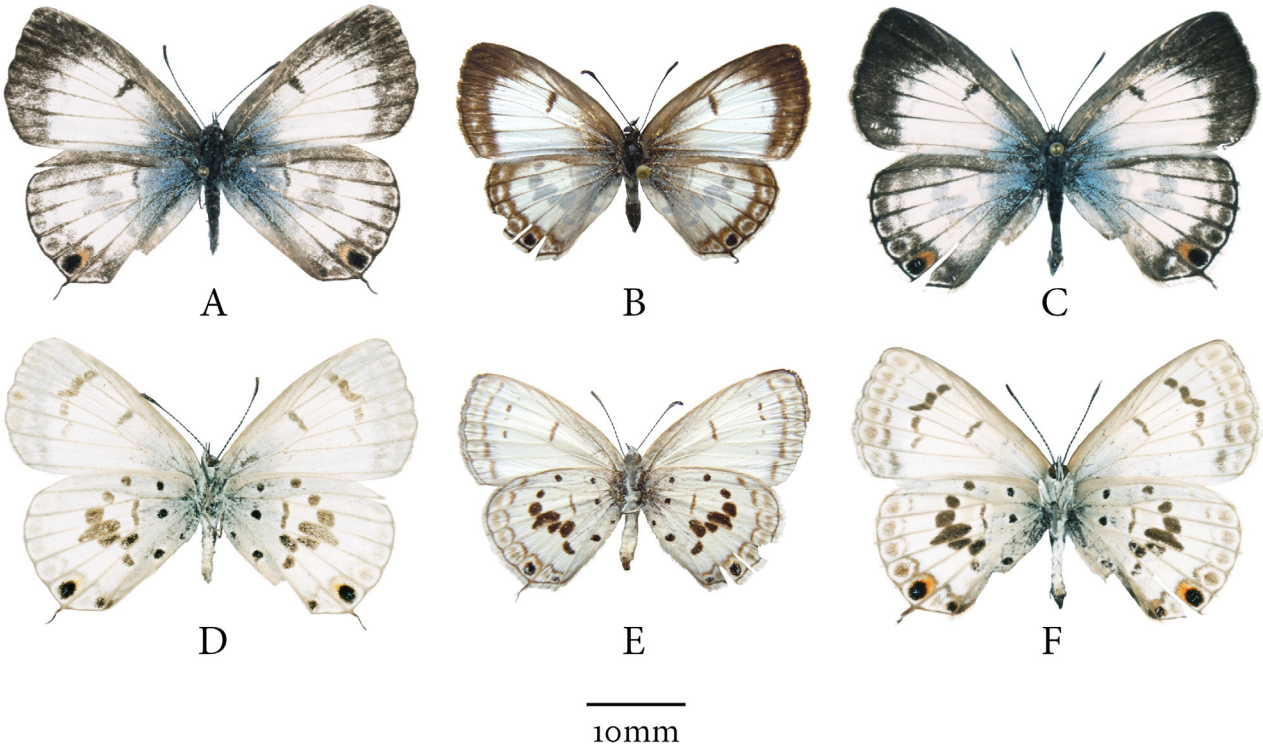

FIGURE 2. Further comparative material of *Lepidochrysops* imagos. *L. liberti* male (paratype): A—upperside, D—underside; *L. phoebe* male, Mount Febe, Cameroon: B—upperside, E—underside; *L. liberti* female (paratype) C—upperside, F—underside.

Note. Unfortunately the holotype of *L. phoebe* is in such poor condition that diagnostic features are hardly visible. We therefore illustrate also a paratype with a paratype of *L. liberti* for better comparison.

Etymology. *L. liberti* is named in honour of Michel Libert, the author of its sister species, *L. phoebe*. Michel dedicated his entire life to the study of African butterflies and has personally authored descriptions of over 100 species from almost all families, including many mountain species from the Gulf of Guinea Highlands. Without his thorough work revising various groups, many genera would still remain a taxonomic mess.

Habitat and behaviour. *Lepidochrysops liberti* occurs in a mosaic-like landscape that is strongly affected by extensive natural disturbances by forest elephants. Permanent foraging activity of the elephants has resulted in a diverse network of open clearings dominated by grasses and ferns and regenerating young trees and shrubs between fragments of old-growth thick submontane forest. Such open habitats have already been discussed to be crucial for various (sub)montane butterflies of the region (Tropek & Konvicka 2010, Tropek *et al.* 2013). *L. liberti* flies along the edges of forest patches and in scrubby openings. Very often it has been observed near stands of a creeping perennial herb *Solenostemon mannii* (Hook.f.) Baker (Lamiaceae) which could be a potential food plant, although no egg-laying was observed. Along larger stands of this plant, males were displaying and fighting together; they also regularly perched on leaves of the plant. Judging from the distribution of *S. mannii* in the study area, as well as from the majority of the observed butterfly specimens, *L. liberti* seems to live in patchily distributed smaller colonies, which are most probably connected, as *L. liberti* specimens were also observed readily flying over forest patches or passing through larger, visibly unsuitable clearings.

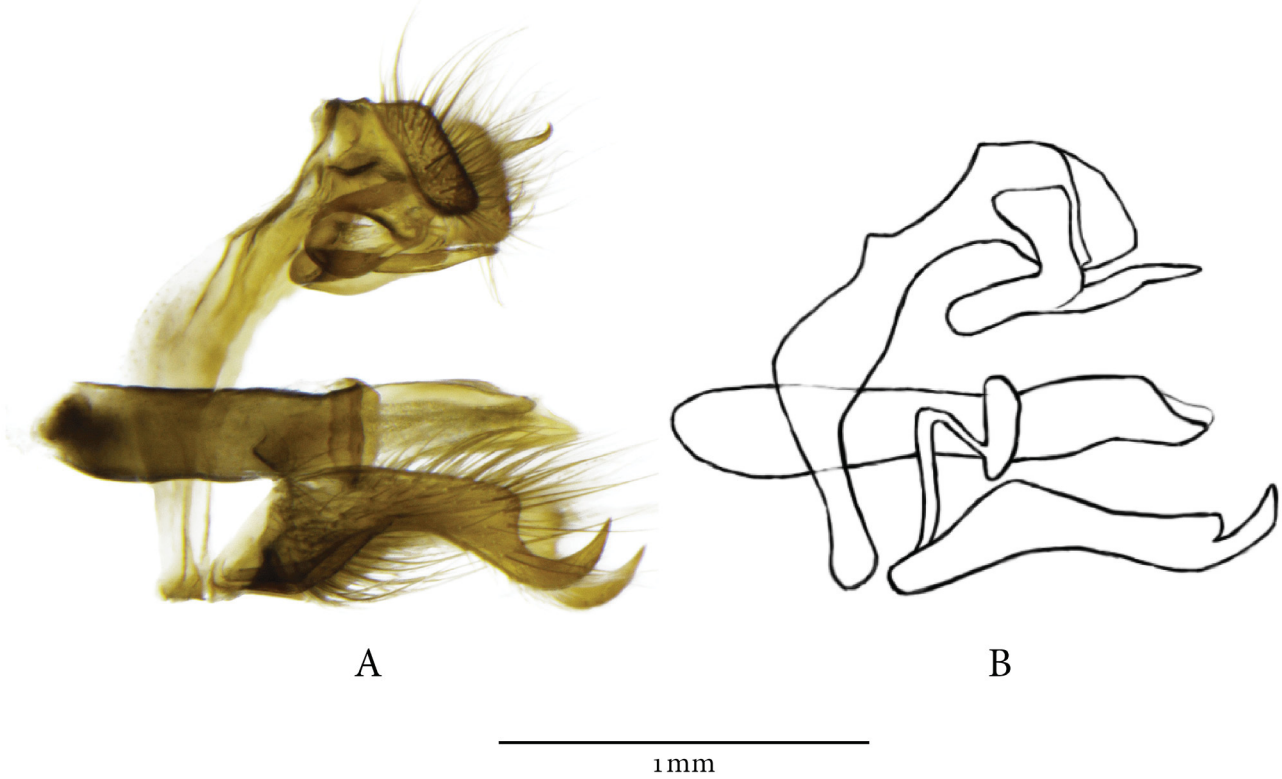

FIGURE 3. Male genitalia of *L. liberti* (holotype) and *L. phoebe* (holotype) (the latter one was re-drawn from the original illustration in Libert 2001).

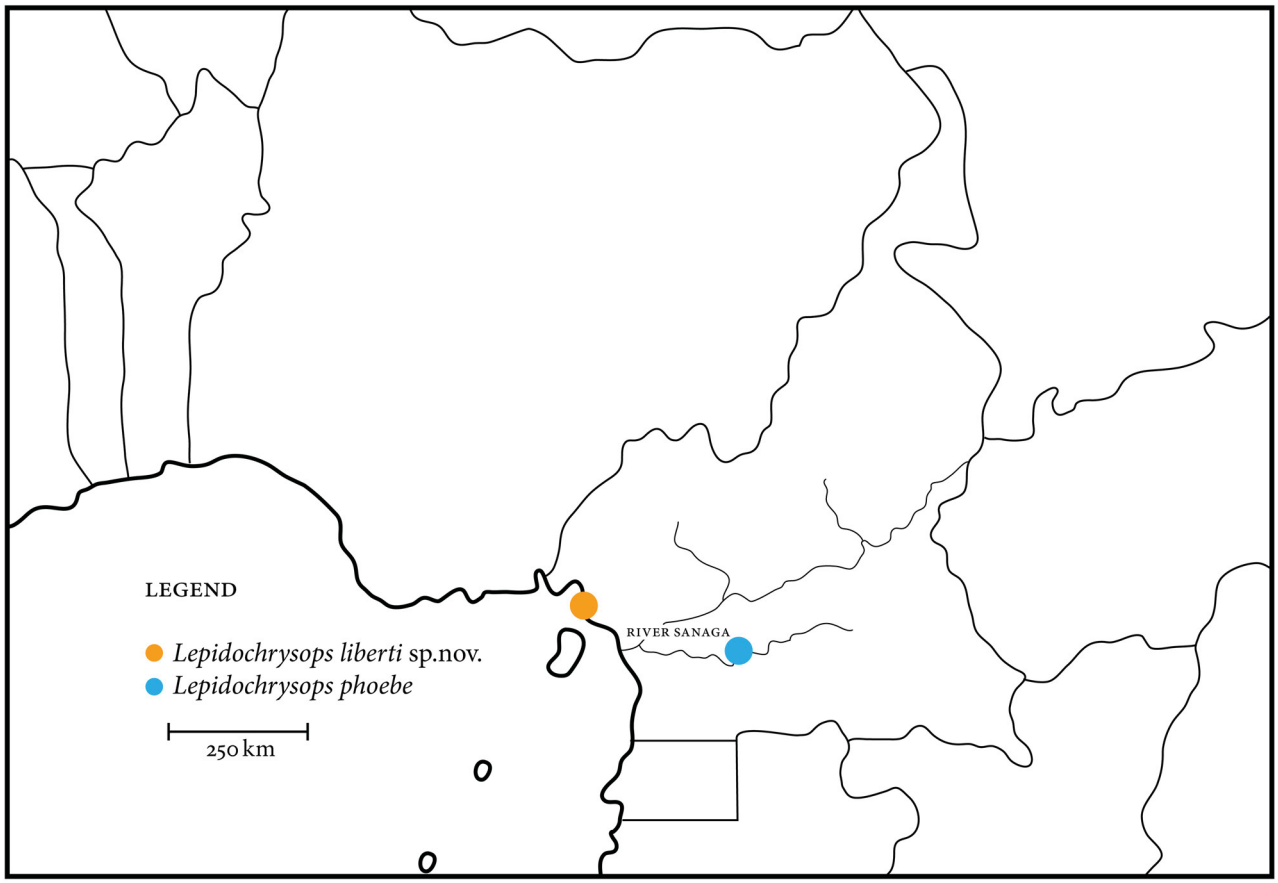

FIGURE 4. Known distribution of *L. liberti* and *L. phoebe*.

HESPERIIDAE Latreille, 1809

Incertae sedis

***Ceratrichia* Butler, 1870**

***Ceratrichia fako* sp. nov.**
(FIGS: 5A, D, G, J; 6A, D; 7)

Holotype. ♂ PlantiCam camp, the main tourist trail, south-western slope of Mount Cameroon, South-West Province, Cameroon; 23.XI–18.XII.2014. Leg.: Sáfián, Sz. & Tropek, R. Gen. prep.: SAFI00079. Coordinates: N 04.117°, E 09.073°; elevation: 1100 m a.s.l.

Paratypes. 1♂ Buea-Bokwaongo trail (1700 m), southern slope of Mount Cameroon, South-West Province, Cameroon; XI.2014. Leg.: Sáfián, Sz.; 7♂♂ 3♀♀ PlantiCam camp and above along the main tourist trail (1100–1500 m), south-western slope of Mount Cameroon, South-West Province, Cameroon; 23.XI–18.XII.2014 and 07–23.IV.2015. Leg.: Sáfián, Sz. & Tropek, R.

Description of the holotype. Forewing: 14 mm. Wingspan: 27 mm. The upperside is chocolate brown, scattered with golden-brown scaling of variable density over both wings. The golden scaling is particularly dense in the basal area of the forewing and on most of the hindwing, where even long golden-brown hairs are present. The forewing underside is also chocolate brown, with a prominent yellow band along the costa, which becomes diffuse in the apical area, dusting around six small white spots (one of which is found in the discoidal cell). The hindwing underside is bright yellow, with a prominent chocolate brown margin, which is dusted by golden-brown scales. Five small brown spots are also present in the yellow area of the hindwing, as well as a whitish spot in the brown margin. The body is blackish-brown from the dorsal side, covered by golden-brown hairs. Ventrally, the body is yellow with long yellow hairs on the thorax. The legs are brown and yellow; the palpi are yellow with brown hairs. The antennae are very long, dark brown, ringed with yellow. Their tips are broadened, gently hooked. The eyes are large, bald, dark grey.

Male genitalia. Uncus funnel-shaped with very long and narrow tip, scaphium is present, well developed, narrow, long. Tegumen is hood-like, saccus short, weakly sclerotized. Valvae are symmetrical, their cucullus is quite blunt. The aedeagus is short, trumpet-like (teste Larsen) very weakly sclerotized. It tapers down into a slim curving posterior tip, while the vesica is broad and blunt.

Description of the female. In size and appearance, the female of *C. fako* is very similar to the male, however six hyaline spots are present in the sub-apical area of the forewing of the female.

Diagnosis. *C. fako* is obviously closely related to *C. lewisi* and the recently described *C. manengouba*, with the following differences, which are consistent over the large available series. The hindwing upperside of both sexes of *C. lewisi* has an extensive yellow patch along the outer margin, covering almost half of the wing, which is missing completely from *C. fako,* replaced by an overlay of dense golden-brown scales. Uppersides of both wings of *C. fako*, and especially the hindwing, are slightly overlaid by golden-brown scales, distinguishing it from both of its relatives. The ground colour of *C. manengouba* is generally darker; in its description, Larsen & Collins (2014) state that: “Upperside of both sets of wings uniformly deep black”; while the ground colour of *C. fako* is significantly lighter—it is a warm dark chocolate brown.

Etymology. The species is named after Fako, the local name of Mount Cameroon, the type locality of the species.

Habitat and behaviour. The first specimen was found at 1700 m a.s.l. in the sub-montane forest of Mount Cameroon, above the town of Bokwaongo-Buea. It was flying in the usual short skipping flight typical for various *Ceratrichia* species, in a small clearing surrounded by tree-ferns. The rest of the type series (including the holotype) were collected during various occasions over two seasons (Nov–Dec 2014 and April 2015) between 1100 and 1500 metres, just above the PlantiCam camp. All the caught and observed specimens occurred in the upland-sub-montane transitional forest along the main tourist trail on the south-western slope of Mount Cameroon. The species is much less common than *C. clara* with which it flies in syntopy, although *C. fako* seems to be much more localized, restricted usually to the darker bottom of the rocky ravines, where sun can only patchily penetrate the forest understorey. The males usually perch on a sun-lit leaf of fern or low bush, and patrol around regularly for a

couple of metres before settling on the same perch or a nearby spot. The sub-montane *C. flava* prefers to stay along the edges of clearings in the habitat mosaic, where *C. fako* does not usually venture out.

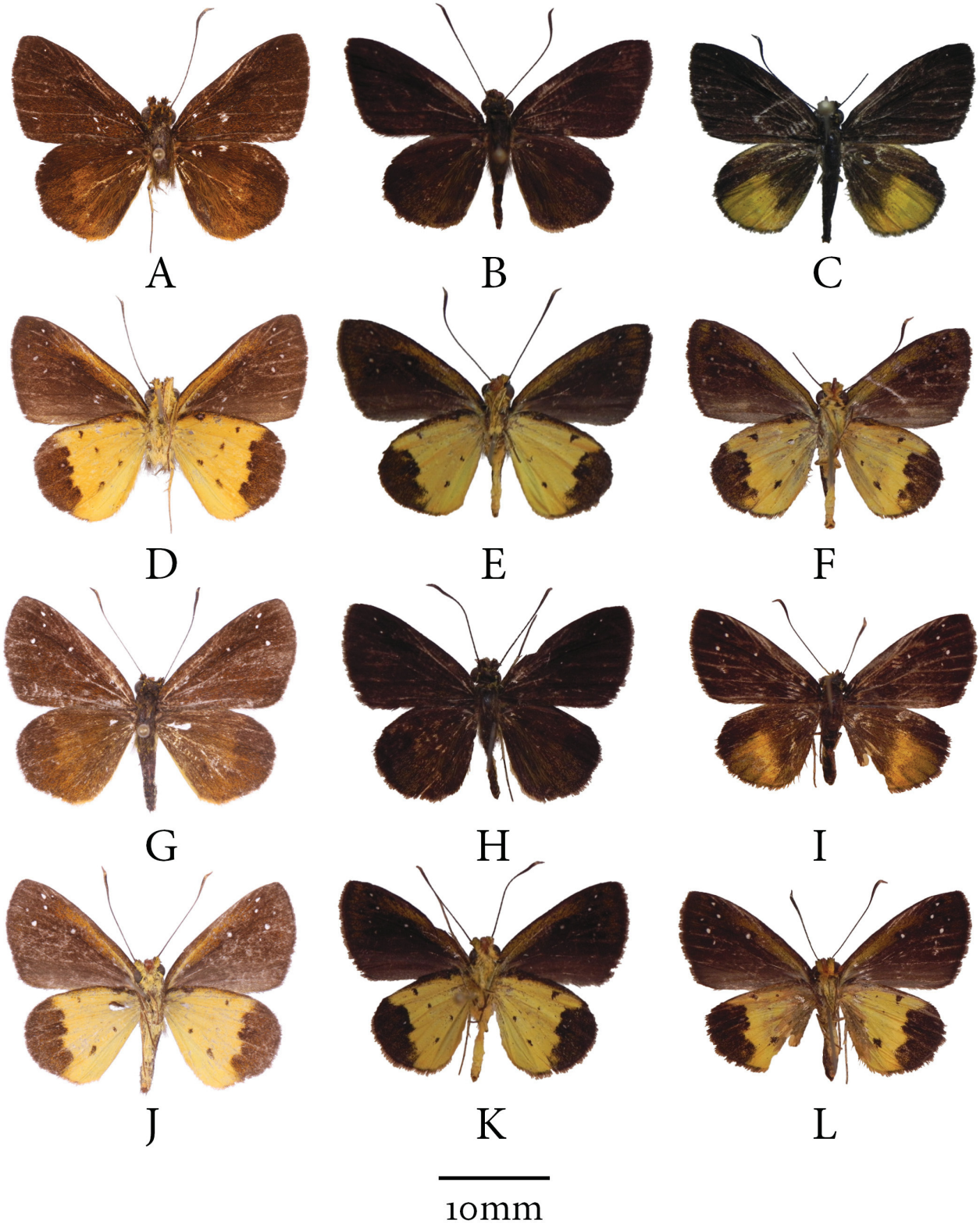

FIGURE 5. *C. fako* (holotype): A—upperside, D—underside; *C. manengouba* (holotype): B—upperside, E—underside; *C. lewisi* male, Obudu Plateau, Nigeria: C—upperside, F—underside; *C. fako* female (paratype): G—upperside, J—underside; *C. manengouba* female (paratype) :H—upperside, K—underside; *C. lewisi*, Obudu Plateau, Nigeria: J—upperside, L - underside (*C. lewisi* and *C. manengouba* images are ex-Larsen, ABRI).

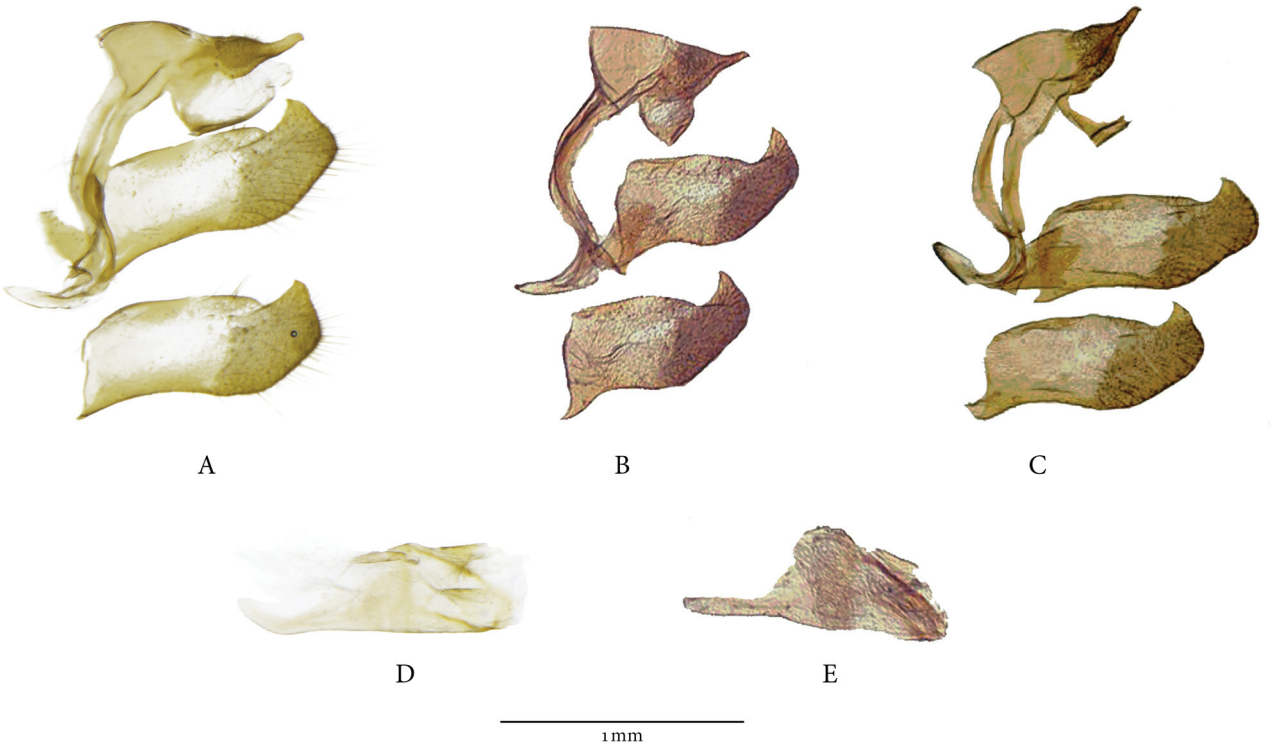

FIGURE 6. Male genitalia with removed aedeagi: A—*C. fako* (holotype), B—*C. manengouba* (holotype), C—*C. lewisi* (holotype); D—*C. fako* aedeagus (holotype), E—*C. manengouba* aedeagus (holotype) (genitalia of *C. lewisi* and *C. manengouba* ex-Larsen & Collins 2014).

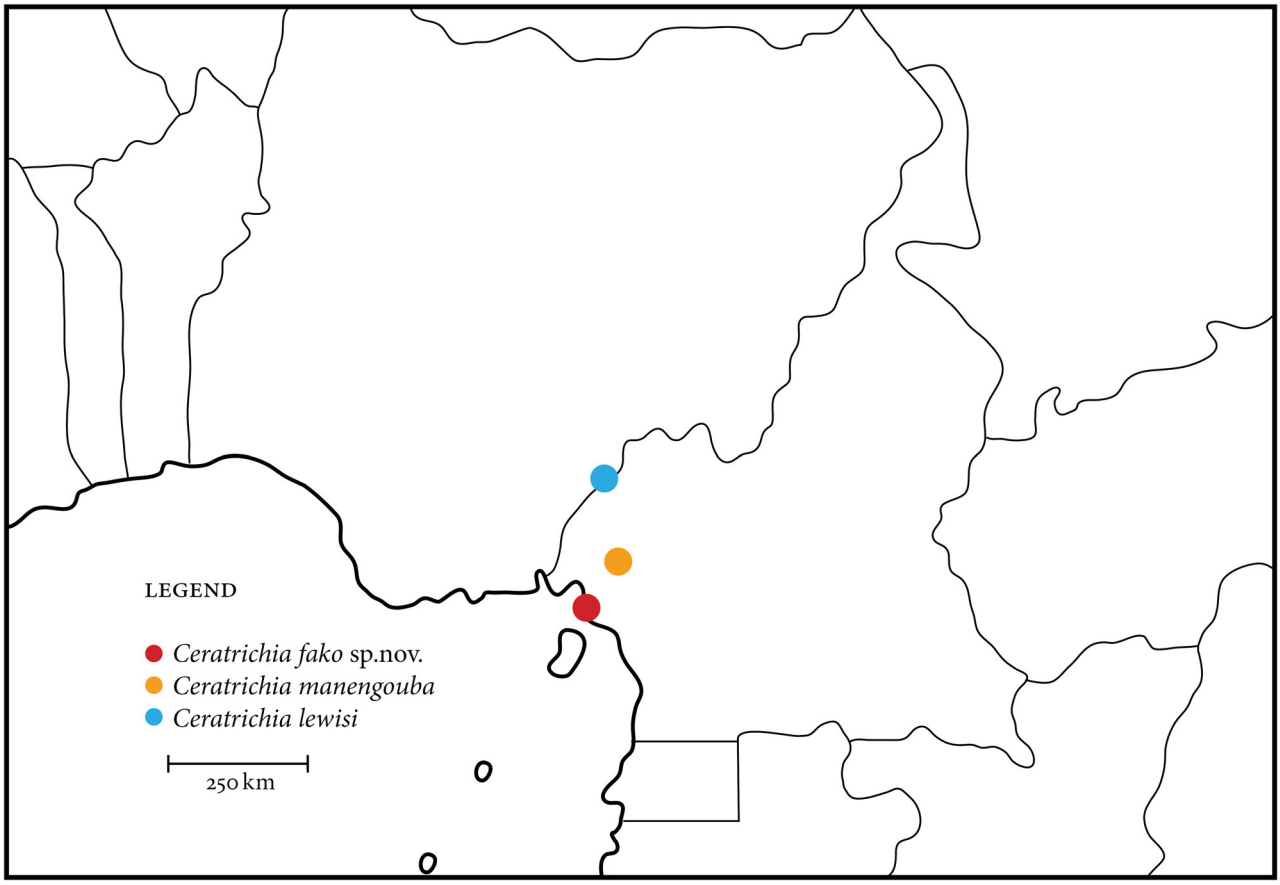

FIGURE 7. Known distribution of *C. fako*, *C. manengouba* and *C. lewisi*.

Discussion on the taxonomic decision and biogeography of the new species

Both new species are border-cases, where it could be argued whether they truly represent distinct species, or would rather deserve sub-specific status based solely on the morphology of the examined populations and the fact that all taxa are clearly allopatric. For our decision, we applied evolutionary criteria of the general lineage species concept (de Queiroz 2007) incorporating biogeographic information; the biogeography of the species—as it is not usually sufficiently emphasized in species delimitation (de Queiroz 2007)—is discussed below.

In *Lepidochrysops* the two taxa are treated as vicariant specialists; each of them occupies a restricted but very unique habitat in the sub-montane zone of two completely isolated mountains: Mount Febe—Mont Fébé (Yaoundé, Central Province, Cameroon) and Mount Cameroon (South-West Province, Cameroon). The distribution areas of the two are not only separated by completely unsuitable habitat (lowland forest area), but they clearly fall into two separate biogeographic sub-regions: *L. liberti* being West African of the Gulf of Guinea Highlands, whereas *L. phoebe* is clearly Central African, as Mount Febe—Mont Fébé (Yaoundé) lies 50 km south-west of the Sanaga River, the recognised biogeographic border between West and Central Africa regions for butterflies (Larsen 2005) (Fig. 4). Although it cannot be completely ruled out that either species will be found in other sub-montane habitats in the vicinity of their respective type localities, this will not change the general approach towards their taxonomic status, as the isolation between the two regions is far too great to accept the conspecificity of the two.

Although geographically *C. lewisi* and *C. manengouba* occur relatively close to Mount Cameroon (*C. lewisi* ~230 km, *C. manengouba* ~110 km), Larsen & Collins (2014) distinguished *C. manengouba* as specifically distinct from *C. lewisi*, which is found on the Obudu Plateau (Adamawa State, Nigeria), only 150 km northwest of Mount Manengouba (South-West Province, Cameroon) (Fig. 7). Considering morphological differences in wing patterns and genitalia among all the three taxa, the conclusion of Larsen & Collins (2014) is supported, and *C. fako* is recognised as a separate species, as the three taxa are morphologically equally distinct compared to other recognised species within the genus.

Our conviction on the evolutionary separation of both species from their described relatives is supported also by the fact that Mount Cameroon generally shows extreme speciation potential as an isolated massif. Altogether 49 plants (Cable & Cheek 1998), two birds and three small mammals (MINFOF 2014) are narrowly endemic to Mount Cameroon. Of butterflies, *Charaxes musakensis* Darge, 1973 is known to be restricted to the higher sub-montane and montane forests of Mount Cameroon (Henning 1988). The status of an undescribed, endemic *Neptis* is currently under revision (S.C. Collins pers. comm.); as is the status of *Papilio echerioides zoroastres* Druce, 1878, which occurs only on Mount Cameroon and on the island of Bioko, with no known population in northern part of the Gulf of Guinea Highlands (Tropek *et al.*, unpublished data). The strong isolation and/or the highly specific environment of Mount Cameroon are also evidenced by the fact that only a very small proportion of (sub)montane butterflies are shared with the surrounding mountainous areas in the region. Many relatively common taxa that occur in the majority of mountain ranges in Western Cameroon and Eastern Nigeria: *Colias electo manengoubensis* Darge, 1968, *Tuxentius margaritaceus* (Sharpe, 1892), *Ypthima albida occidentalis* Bartel, 1905, *Acraea obliqua obliqua* (Aurivillius, 1913), *Telchinia uvui balina* (Karsch, 1892) etc., are not known to occur in Mount Cameroon (Tropek *et al.,* unpublished data).

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We thank Michel Libert for providing us photographs of the type series of *L. liberti*, original drawings of its genitalia and for numerous discussions on Afrotropical butterflies. We are also grateful to several other colleagues for their help: Rodolphe Rougerie (NHMP) took pictures of the *L. liberti* holotype; Steve C. Collins kindly allowed us examination of the comparative material in ABRI; Renátó Molnár helped with the digital processing and editing of plates and maps, while Jadwiga Lorenc prepared and photographed the genitalia of both newly described species. Several colleagues and assistants helped us extensively in the field, especially Vincent Maicher, Štěpán Janeček, Joseph Brophy, Francis E. Luma and John Ngoto; Š. Janeček also identified the potential food plant of *L. liberti*; Eric B. Fokam from the University of Buea crucially helped us with all necessary research and export permits and together with his students accompanied us in the field. Matthew Sweney corrected our English. We thank the Mount Cameroon National Park staff for their help, with special thanks to Simon Besong, the main

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